NICE³
Success Story

Brick Kiln Design Using Low - Thermal-Mass Technology

Innovative Brick Kiln Uses Low Thermal Mass and Low No_x Technologies to Save Energy and Reduce Emissions

Benefits

- Offers energy savings of 35% over conventional tunnel kiln technology
- Through 2000, has cumulatively saved over 110 billion Btu in natural gas
- Improves product quality and reduces product loss by 50%
- Through 2000, has cumulatively saved over $380,000 because of reduced natural gas usage
- Reduces air emissions from reduced natural gas use
- Through 2000, has cumulatively reducted NO_x emissions by over 8 tons and CO_2 emissions by over 6,600 tons
- Increased productivity by 100% compared with existing tunnel kiln technology

Applications

High-volume brick production using tunnel kiln technology.

The production of architectural and structural bricks starts with clay that is ground, sifted, and mixed with water Once mixed, the clay is extruded to the required shape and then cut to the appropriate length. In its final shape, the bricks are stacked onto kiln cars for transport to the tunnel kiln for drying and firing.

Tunnel kilns are long, continuously operated kilns that receive bricks on track-mounted cars called kiln cars. These cars are fed into the kiln, one after another, and are pulled through the kiln's different drying and firing sections. A typical tunnel kiln may be up to 200 feet long.

High–Efficiency Low-Thermal-Mass Brick Kiln

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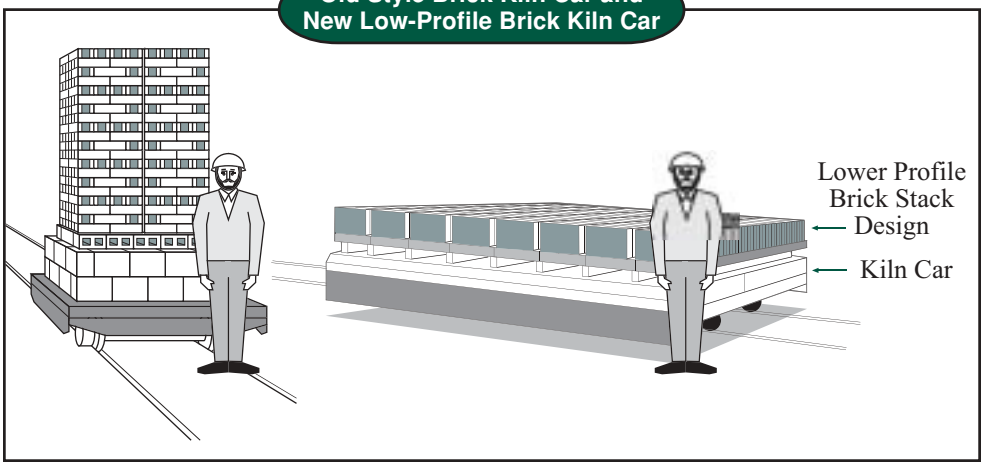
In traditional tunnel kilns, the kiln cars are stacked with bricks about six feet high. These cars are then put on the tracks and enter the drying portion of the kiln where they remain for about 48 hours to reduce the moisture content. After drying, the bricks enter the firing portion of the kiln, which is usually between 1,900°F and 2,300°F; the temperature varies with the brick type and finish desired. The bricks remain in the firing portion of the kiln also for about 48 hours.

High-Efficiency Low-Thermal-Mass Brick Kiln

While effective, the traditional tunnel kiln suffers from long production cycles, high energy intensity, relatively high rejection rates (~10%), and low levels of automation – in many phases of the traditional process, bricks are moved and stacked manually.

To address these issues, Pacific Clay Products, Inc. (Pacific Clay) teamed with Swindell Dressler International Co. (a kiln manufacturer), and the U.S. Department of Energy's NICE³ (National Industrial Competitiveness through Energy, Environment, and Economics) program to demonstrate a new high-efficiency tunnel kiln technology. This new kiln technology, called a low-thermal-mass kiln, was designed to offer higher production rates, lower energy intensities, and reduced rejection rates.

Old Style Brick Kiln Car and New Low-Profile Brick Kiln Car



"Yes, we'd definitely do it again."

"Installing this new kiln was like having children. While your doing it you're not always sure it's a good idea. But when you're done, you're glad you did it."

– Alan Cunningham
Vice President
Pacific Clay Products, Inc.
Lake Elsinore, CA

OFFICE OF INDUSTRIAL TECHNOLOGIES

ENERGY EFFICIENCY AND
RENEWABLE ENERGY
U.S. DEPARTMENT OF ENERGY

Project Partners

- Pacific Clay Products, Inc.
  Lake Elsinore, CA
- Swindell Dressler International Company
  Pittsburgh, PA
- California Energy Commission
  Sacramento, CA

Technology Description

The benefits of the Swindell Dressler high-efficiency, low-thermal-mass tunnel kiln stem from design and automation improvements over traditional tunnel kilns. These new designs use high-efficiency, low-NO_x gas burners, higher levels of insulation, a lower profile (1- to 2- foot brick stack), lower thermal-mass kiln cars, and improved burner placement. The benefits of this technology are summarized below.

Design Feature	Performance Benefit
High-efficiency, low-NO_x pulse gas burners	Increased energy efficiency, reduced NO_x emissions
Ceramic fiber insulation in lieu of traditional refractory brick on the inside walls of the kiln	Faster kiln heat-up after shutdown or turndown, increased energy efficiency and productivity
Low-thermal-mass kiln cars	Faster kiln heat-up after shutdown or turndown, increased energy efficiency and productivity
Lower profile kiln cars	Improved heat penetration into the center of the brick mass, reduced firing times, and reduced product loss
Improved burner placement	Improved heat circulation, reduced firing times, and increased productivity

Technology Impact and Savings

The low-thermal-mass kiln technology is providing many benefits. Most importantly to Pacific Clay is the improved energy efficiency, reduced pollution, and increased production capacity.

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Energy Savings

Energy savings realized by the new kiln result from the high-efficiency gas burners, better insulation in the kiln, and the low-thermal-mass kiln cars. Gas metering indicates that the new kiln saves about 35% in natural gas use. At Pacific Clay the annual gas savings is estimated to be 240 million Btu.

Pollution Savings

The low-NO_X burners installed in the new kiln benefit Pacific Clay because the local air-quality board enforces strict air emissions limits. This new kiln was found to reduce NO_X emissions by 28%, which extends Pacific Clay's bank of NO_X credits and allows them to trade these on the open market.

The table below presents the impacts and savings of the new kiln compared with the old kiln.

Characteristic	Old Kiln	New Kiln	Improvement
Production capacity *(tons/year)*	30,000	60,000	100%
Production loss rate *(%)*	8%-13%	5%	50%
Production time *(hours)*	96	48	50%
Natural gas consumption *(therms/ton)*	67.3	43.6	35%
NO_X emissions *(lb/ton of brick)*	0.377	0.270	28%

New Market Opportunities

With reduced operating costs and high productivity, Pacific Clay is more competitive in national markets, including the East coast, despite shipping costs. The new kiln also allows Pacific Clay to increase the range of its production capacity. They now manufacture new premium and high-value products, such as wall caps and a decorator line of terra cotta pots. The new products carry a 25% premium over Pacific Clay's standard product line.

NICE³ Program

NICE³ – National Industrial Competitiveness through Energy, Environment, and Economics: An innovative, cost-sharing program to promote energy efficiency, clean production, and economic competitiveness in industry. This grant program provides funding to state and industry partnerships for projects that demonstrate advances in energy efficiency and clean production technologies. Awardees receive a one-time grant of up to $525,000. Grants fund up to 50% of total project cost for up to 3 years.

NICE³ Program Manager: Lisa Barnett (202) 586-2212.

For additional information, please contact:

Jim Walsh
Swindell Dressler International Company
P.O. Box 15541
Pittsburgh, PA 15244
Phone: (412) 788-7100
Fax: (412) 788-7110
jwalsh@swindelldressler.com

For more information about the NICE³ Program, contact:

Lisa Barnett
NICE³ Program Manager
Phone: (202) 586-2212
Fax: (202) 586-7114
lisa.barnett@ee.doe.gov

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Office of Industrial Technologies
Energy Efficiency
and Renewable Energy
U.S. Department of Energy
1000 Independence Avenue SW
Washington, D.C. 20585-0121

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